

WHAT IS CLAIMED IS:

- 1 1. A laser, comprising:
  - 2 an optically resonant cavity defined by two or more reflecting surfaces;
  - 3 a substantially <100>-oriented crystal disposed within the cavity, wherein the crystal is
  - 4 characterized by a crystal orientation such that a <100> plane of the crystal is oriented
  - 5 substantially perpendicular with respect to a direction of propagation of a beam of
  - 6 stimulated radiation within the crystal; and
  - 7 a pump source configured to provide pumping energy to a pumped region of the crystal,
  - 8 wherein an absorbed pump power of the pumping energy is less than about 1000 watts
  - 9 and/or a cross-sectional overlap between a beam of radiation propagating through the
  - 10 crystal and the pumped region is greater than about 20% of a cross-sectional area of the
  - 11 pumped region,
  - 12 wherein the use of the substantially <100>-oriented crystal reduces depolarization loss or
  - 13 thermal lensing compared to a substantially similarly configured gain medium made from
  - 14 the same material as the substantially <100>-oriented crystal but having instead a
  - 15 substantially non-<100>-orientation.
- 1 2. The laser of claim 1 wherein a diameter of a beam of radiation propagating through the
- 2 crystal is greater than about 45% of a diameter of the crystal.
- 1 3. The laser of claim 1 wherein the crystal is not naturally birefringent.
- 1 4. The laser of claim 1 wherein the crystal has a simple cubic structure.
- 1 5. The laser of claim 1 wherein the crystal is selected from the group of yttrium aluminum
- 2 garnet (YAG) and gadolinium scandium gallium garnet (GSGG).
- 1 6. The laser of claim 1, wherein the crystal is yttrium aluminum garnet (YAG).
- 1 7. The laser of claim 1 wherein the crystal is Tm:Ho:YAG, Yb:YAG, Nd:YAG or Er:YAG.
- 1 8. The laser of claim 1 wherein the crystal is Nd:YAG.

- 1 9. The laser of claim 1 wherein the pump source is configured to provide the pumping  
2 energy through a side of the crystal that is oriented substantially parallel to the direction  
3 of propagation.
- 1 10. The laser of claim 9 wherein the crystal is disposed within a pump cavity configured to  
2 reflect the pumping energy back into the crystal.  
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- 1 11. The laser of claim 10, further comprising one or more beam-shaping elements configured  
2 to provide the beam of stimulated radiation with a substantially elliptical cross-section  
3 within the crystal.
- 1 12. The laser of claim 1 further comprising first and second non-linear elements configured  
2 such that the laser is a frequency tripled laser.
- 1 13. The laser of claim 12, wherein the first and second non-linear elements are disposed  
2 within the cavity, whereby the laser is an intracavity frequency-tripled laser.
- 1 14. The laser of claim 1, wherein the crystal gain medium is oriented such that the  
2 polarization of the stimulated radiation is directed substantially along a diagonal between  
3 two crystal axes other than the  $\langle 100 \rangle$  axis.
- 1 15. A method for reducing depolarization loss or thermal lensing, in a gain medium in a laser  
2 or optical amplifier, the method comprising:  
3 using as the gain medium, a crystal characterized by a crystalline orientation such that a  
4  $\langle 100 \rangle$  plane of the crystal is oriented substantially perpendicular with respect to a  
5 direction of beam propagation within the crystal; and  
6 providing pumping energy to a pumping region of the crystal,  
7 wherein an absorbed pump power of the pumping energy is less than about 1000 watts  
8 and/or a cross-sectional overlap between a beam of radiation propagating through the  
9 crystal and the pumped region is greater than about 20% of a cross-sectional area of the  
10 pumped region,  
11 wherein the use of the substantially  $\langle 100 \rangle$ -oriented crystal reduces depolarization loss or  
12 thermal lensing compared to a substantially similarly configured gain medium made from  
13 the same material as the substantially  $\langle 100 \rangle$ -oriented crystal but having instead a  
14 substantially non- $\langle 100 \rangle$ -orientation.

- 1 16. The method of claim 15 wherein a diameter of a beam propagating through the crystal is  
2 greater than about 45% of a diameter of the crystal.
- 1 17. The method of claim 15 wherein the crystal is a fluoride crystal or an oxide crystal.
- 1 18. The method of claim 15 wherein the crystal is not naturally birefringent.
- 1 19. The method of claim 15 wherein the crystal is selected from the group of yttrium  
2 aluminum garnet (YAG) and gadolinium scandium gallium garnet (GSGG).
- 1 20. The method of claim 15, wherein the crystal is yttrium aluminum garnet (YAG).
- 1 21. The method of claim 15 wherein the crystal is Tm:Ho:YAG, Yb:YAG, Nd:YAG or  
2 Er:YAG.
- 1 22. The method of claim 15 wherein the crystal has a simple cubic structure.
- 1 23. The method of claim 15 wherein the crystal is disposed within an optical cavity of a laser.
- 1 24. The method of claim 15 wherein providing energy to the pumping region of the crystal  
2 includes side-pumping the crystal.
- 1 25. The method of claim 15 wherein the crystal gain medium is oriented such that the  
2 polarization of the stimulated radiation is directed substantially along a diagonal between  
3 two crystal axes other than the  $\langle 100 \rangle$  axis.
- 1 26. The use in a laser or optical amplifier as a gain medium of a crystal characterized by an  
2 orientation such that a  $\langle 100 \rangle$  plane of the crystal is oriented substantially perpendicular  
3 with respect to a direction of beam propagation within the crystal, wherein the crystal  
4 absorbs a power less than or equal to about 1000 watts of pumping energy and/or a cross-  
5 sectional overlap between a beam of radiation propagating through the crystal and a  
6 pumped region of the crystal, is greater than about 20% of a cross-sectional area of the  
7 pumped region of the crystal,  
8 wherein the use of the substantially  $\langle 100 \rangle$ -oriented crystal reduces depolarization loss or  
9 thermal lensing compared to a substantially similarly configured gain medium made from  
10 the same material as the substantially  $\langle 100 \rangle$ -oriented crystal but having instead a  
11 substantially non- $\langle 100 \rangle$ -orientation.

- 1 27. The use of claim 26 wherein a diameter of a beam propagating through the crystal is  
2 greater than about 45% of a diameter of the pumped region of the crystal.
- 1 28. The use of claim 26 wherein the crystal is not naturally birefringent.
- 1 29. The use of claim 26 wherein the crystal has a simple cubic structure.
- 1 30. The use of claim 26 wherein the crystal is selected from the group of yttrium aluminum  
2 garnet (YAG) and gadolinium scandium gallium garnet (GSGG).
- 1 31. The use of claim 26, wherein the crystal is yttrium aluminum garnet (YAG).
- 1 32. The use of claim 26 wherein the crystal is Tm:Ho:YAG, Yb:YAG, Nd:YAG or Er:YAG.
- 1 33. The use of claim 26 wherein the crystal is Nd:YAG.
- 1 34. The use of claim 26 wherein the pumping energy is provided to the pumped region by  
2 side-pumping the crystal.
- 1 35. The use of claim 26 wherein the crystal gain medium is oriented such that the  
2 polarization of the stimulated radiation is directed substantially along a diagonal between  
3 two crystal axes other than the <100> axis.
- 1 36. An optical amplifier, comprising a gain medium in the form of a crystal characterized by  
2 an orientation such that a <100> plane of the crystal is oriented substantially  
3 perpendicular with respect to a direction of beam propagation within the crystal, wherein  
4 the crystal absorbs a power less than or equal to about 1000 watts of pumping radiation  
5 and/or a cross-sectional overlap between a beam of radiation propagating through the  
6 crystal and a pumped region of the crystal, is greater than about 20% of a cross-sectional  
7 area of the pumped region of the crystal,  
8 wherein the use of the substantially <100>-oriented crystal reduces depolarization loss or  
9 thermal lensing compared to a substantially similarly configured gain medium made from  
10 the same material as the substantially <100>-oriented crystal but having instead a  
11 substantially non-<100>-orientation.

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